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GUATEMALA FORESTS.

BY MILES ROCK.

IN a general view over the surface of Guatemala we observe a great difference in the character of the vegetable covering. Little of this difference can be due to change in latitude, as the whole Republic lies within the parallels of 13° 44′ and 17° 49′, or extends only about 4 degreees north and south. In longitude, it lies between 78° 8′ and 92° 10′ west of Greenwich, or extends also 4° east and west. Roughly it is in the form of a square, of which these dimensions of 4° are the diagonals. This country is the northwestern one of the five Central American republics, and covers about one-fourth of their entire area, and is about as large as the State of Pennsylvania, 43,000 square miles, but has hardly one-third the number of inhabitants—say one and one-third millions.

What, then, are the causes of the plant diversity? They are, undoubtedly, 1st, elevation above sea level; 2d, meteorological influence of topographical features on climate; and 3d, influence of the ancient inhabitants. The first I take to be the most important cause. We have first the hot climate of the coasts, extending from sea-level to altitudes of 3000 feet, and including

(*a*) The Pacific Coast plain, some 40 miles wide and 135 long, covering 4500 square miles.

(*b*) The Caribbean Sea Coast plain, some 60 by 20 miles, including the valleys of the rivers Sarstun, Dulce, Polichie, Matagua and Zacapa, and Lake Yzabal, or Golfo Dulce, covering 3200 square miles.

(*c*) The Gulf region, or part of the great plain entering northward from the Sierra Madre, or Cuchumatanes Mountains to the Gulf of Mexico, about 150 miles square, including (1) the basin of the river Neumacinta and its four great affluents, the rivers San Pedro, Lacantun, Chixoy and Pasion, and the narrow valleys of their upper branches, covering some 16,000 square miles; (2) the valleys of the Lagartero and Salegná rivers, 250 square miles; and (3) the valley of the Cuilco River, 50 square miles, the last three rivers being the upper affluents of the Chiapas River, all these regions together making 24,000 square miles of *tierra caliente*, or more than one-half the entire country.

Secondly: A great mountain system running nearly east and west from the Isthmus of Tehuantepec to the Gulf of Honduras occupies the middle of Guatemala between the Pacific and the Gulf plains, in a succession of axes of elevation, vaults and escarpments, overlapping or arranged *en echelon*. In some ten places these mountains attain elevations of 10,000 to 12,000 feet, and elevations 8000 to 9000 feet are numerous. Between these are the many deep erosion valleys, pre-tertiary, which, in the eastern and northern parts of the country, are in the low, hot lands, but in the western and southern parts are filled in with volcanic debris, some trachyte, but mostly ashes, forming extensive and curiously level plains, surrounded by high mountains. These ash plains are from 5000 to 7000 feet above the sea, and form the larger part of the temperate region, or *tierra templada*, and are the sites of most of the cities and large towns, the seat of most of the population, and mostly cleared and cultivated, now and since remote times, as shown by ancient remains. These plains are often traversed by impassable barrancos, or ravines with vertical sides eroded through the ash beds since Pliocene times, by small swift rivers, often to depths of 300 or 400 feet.

The temperate regions, from 3000 to 9000 feet above the sea, cover about 15,000 square miles, or one-third of the whole surface of the Republic.

Thirdly: We have the remaining one-tenth of the country, or 4000 square miles, rising above 9000 feet, and in at least two table lands, those of Ixchignan and Chémal, extensive table lands at 11,000 and 11,500 feet, and which are traversed by ridges 1000 feet higher, and finally, there are six volcanic cones attaining from 13,000 to 14,000 feet elevation.

I have one comment more to make on the face of the country to complete the view, as the matter is usually misunderstood. The twelve or more volcanoes of Guatemala, of which only two show a slight activity, do not form the culminating points of its mountain masses, but are seated on the southern slopes, facing the Pacific, shooting up in beautiful symmetrical cones, with straight slopes almost from the sea-level to the point, looming up, viewed from the Pacific, in solitary grandeur, 3000 feet above the lofty sierras behind them. It is one of the great and inspiring sights of the world to thus see close together the three cones of Agua, Fuego and Acatenango, and the Spaniards could not help but place them on the escutcheon of Guatemala as the symbol of this beautiful land.

Let us begin at the top of one of these towering, awe-inspiring volcanoes, 14,000 feet above the sea, as Agna, or Tajumulco or Tacaná, and take a general view of the vegetation on our way down to the sea-level. On Tajumulco I spent two days and on Tacaná eight, to make observations. It was bitterly cold, day and night, reaching 8° F. above zero. The piercing winds blew at times so one could hardly stand up. Large lava stones were piled against the tripod to keep the theodolite from falling over. Hail storms, with terrific lightning and crashing thunder enveloped us. Owing to rarity of air some of the people became sick and had to be sent down. The volcano was extinct (Tajumulco), but several acres of calcined and crumbling rock, and fissures and holes lined with sulphur crystals and incrustations show that not many years ago it burned. On a part of the crater rim were stuck many crosses and notched sticks where the Indians come to perform their ancient religious rites. On Tacaná two *Chinams* (priests) came up and performed a sacrificial rite with a turkey in my presence after I convinced them that I was from another country and would not betray them, for such rites are forbidden. The view extended over the coast plain and many miles over the Pacific to an indistinguishable horizon, where sea and sky blended; but at sunset one could see where it came, apparently up in the sky.

Round about the crater was only sterile desolation, but on descending one soon sees dry grasses, low weedy herbs and stunted pines and cedars. From 500 to 1000 feet below begin pine forests that extend down to 9000 feet above sea-level. There are also other trees and shrubs and flowers, the last mostly at the top of precipices, the sides of waterfalls, or wherever the sun can get to the ground.

In tropical woods there is not such a profusion of beautiful flowers as in the colder climates; they are too meek and lowly, can get no sun, and are choked out. I have noticed that where trees can get no hold, as on precipices, the rocky banks of rivers, or on narrow promontories jutting into lakes, a great variety of flowers occur; also in abandoned mountain meadows, where the ancient people cleared the forests away, I have noticed ranunculi, violets, geraniums, fuchsias, begonias, compositæ, lilies, whortleberry, abutilon malvas, the wild dahlia, and a host of others.[1] This general shutting out of the sun from the ground accounts not only for the lack of wild flowers, but also for the striking abundance of twining and climbing plants. On the higher volcanic slopes are many vines, and among others a blackberry and a tomato that go straight up to the tops of the highest trees before they branch out and spread their leaves to the sun. The way to gather berries of both is to cut down the trees, and when a tree falls the Indians run to where the tree-tops land, to get the berries.

At places where large wet surfaces of lava have no covering of soil, they are carpeted over with thick beds of mosses and ferns. In descending the volcano Tacaná, when I first came to such an open place without knowing its character, I began to slide with the green carpet, and, there being no bushes to take hold of, kept on at a dangerous pace until a fallen trunk stopped the avalanche.

The trade winds from the Caribbean Sea bring such abundance of moisture that all summits and slopes exposed to them are incessantly enveloped in mists, and the woods are dripping as with rain. These are also the regions of heaviest rainfall during the rainy season. Owing to this excessive moisture one finds the great tree-fern growing at exceptional altitudes, at 9000 feet and over, above the sea. They attain a height of twenty to thirty feet, and a diameter of trunk of even one foot, and occur in greatest abundance on the north slopes of the volcano Tacaná.

From 11,000 to 8000 feet is truly the forest region, characterized by great variety and heavy growth. There are many hard woods, of beautiful colors, as bright yellow and rosy red, that would be most valuable for cabinet-making were they accessible, but to bring them out would be too costly.

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[1] But orchids, epiphytes and other flowers, as well as ferns, mosses and lichens whose habitat is on trees, abound universally throughout the forests and at all elevations, but varying in species.

I have mentioned the pine already. There are at least three species. One is the *Ocóte*, which is very rich in resin, and is used all over the country for light. In every hut three stakes, or a three-forked stake, is driven into the earth floor; a flat stone, or water-jar, is placed on top about three feet from the ground, and on this a few finely-split sticks of *Ocóte* are kept burning, and a child has the duty of replenishing it from time to time with fresh sticks.

I have seen mule-loads of these split sticks on the way to city markets, and in Guatemala city the *Ocóte* sticks hold their own against the electric light. In the low country, in districts where no *Ocóte* grows, some trunk discovered on a river bank, borne down from the mountains by freshets, is a treasure, and supplies the inhabitants with light until it disappears piecemeal. This pine grows at all elevations in the temperate and cold climates, and is the characteristic tree on the volcanoes, on the ash beds, but here mostly cleared away except in barrancos, and in sandstone soil. There are also some remarkable pine forests near the sea-level. We thus see the pine growing from sea-level to the highest summits, and on the volcanoes to over 13,000 feet high, either in exclusive forests or mixed with other trees. There is a species of pine that is of rare occurrence in the temperate belt. It is called the "holy pine," but I have not learned the reason. Perhaps because crosses can be easily cut from the limbs, from its regular opposite branching. Its needles are very long, and bark smooth.

There is a curious tree belonging to the order of the Compositæ that is confined to a particular elevation in a marked way. It is rather gnarled and crooked in shape, but with trunks over a foot in diameter, and reaching a height of thirty feet. Its leaves are willow-shaped, nearly a foot long, glossy green above and white tomentose beneath, and clustered at the end of the branches. The flowers are yellow, sunflower-like, an inch or more across, and arranged in large racemes. This tree is so entirely wanting at lower levels, and so regularly makes its appearance at 10,000 feet above the sea, that we call it "our 10,000-footer." It hardly extends 1000 feet in vertical range. At these elevations occurs another curious tree looking like a gigantic laurel bush, much twisted, gnarled and recumbent, with a smooth red bark, peeling off like the buttonwood.

Another tree of limited range is the *Pinabete,* a spruce. I have noticed it on the Pacific side, at elevations of 9000 feet. It has given its name, *Pinabete,* to a range of mountains on which it is common.

At the upper limit of the temperate belt begins the occurrence of the cedar, or cypress, a lofty tree of large diameter, forming an extensive forest on the table land of Serchil, east of the volcano Zajumulco. In single trees and groups it occurs on many mountains, and especially in the great steep mountain ravines. This tree is much used by the natives in their constructions, being so easily worked. It is especially used for making planks. These are made by edging a section of a trunk of proper length on opposite sides until the finished plank remains. The trees are of such diameter that a single width serves for benches, tables and doors.

A cedar, perhaps a different species, grows in the hot country, and is used to make *cayukas,* or dug-out canoes, and oars. They are light and durable, and large trunks make canoes that carry many people or heavy loads of corn or salt, perhaps four or five tons. They are very sea-worthy, I have safely crossed a lake in one in a storm when the waves ran three to four feet high.

The most characteristic tree of Guatemala is one whose name or botanical relations I have not learned. It is the tree that densely covers all the higher summits. In the case of pines, cedars and oaks, it is a question whether the forest is primeval, or has grown upon ground once cleared and cultivated, but these summit forests have clearly never been touched by man, and in the deep recesses of these woods among mossy rocks, in dripping mists and shut in from the sun one can feel that he is where no human being has ever been before. These trees have large and lofty bare trunks, in appearance like our white oak, but the tops, from the small, glossy green leaves and the dense spray look like the box, and we call it the "box-tree." Where these forests occur I have never found any ruins, and I am sure man has never occupied that ground. On those table lands and slopes where the forests of this tree have been cut off, they do not appear to grow again, but are replaced by pine, or remain clear and afford pasture for flocks of sheep, from which the Indians derive the wool for their clothing and blankets.

These extensive pastures are close-cropped, and poor because of two creeping herbs that carpet the ground, flat and close-pressed to the surface. One of these is a geranium. These pastures have existed probably for centuries, and are mostly above 9000 feet. Below this altitude, next below these pastures, considerable wheat is grown; also some corn, but this does not thrive well above 8000 feet, but below that elevation it is the principal crop to the sea-level, and is the universal and chief food of all the people.

At 8000 to 9000 feet we are also in the region of the potato. These are small, but have such a nutty and delicious flavor that, cooked in their jackets one can eat them like nuts, without any accompaniment; not even salt seems necessary. They are never planted, but in the dry season a row of men and women begin at the bottom of a slope and hoe the ground down-hill-ward, picking up all the tubers that appear, and enough remain for seed for the next crop, while at the same time the ground is made mellow for their sprouting, all over the ground as if they had been sown. These potatoes are packed in nets or large leaves lined with grass, and carried on the Indian's back to the lower country and the cities for sale.

To make the story complete I must add oats to the list for this region, but they are raised only to a small extent, and not at all by Indians, and only for the horses of the hated white man.

And now we must descend lower and leave this lovely and attractive region of bright sun and balmy breezes on one day, or on one side of a mountain, and of driving mists and chilly winds on the other. The conditions of life seem near perfection, no enervating heat, no insects, no malaria, seldom frost, and no snow, hail, or other inclemency. It is a sanitarium unexcelled, and would be a perfect resort for summer or winter, and may be when the Inter-Continental Railway is built. On these charming *altos* and table-lands the native races have lived for ages, slowly gaining headway on the forests and deriving a subsistence, as do their descendants at the present day, by the cultivation of *corn* chiefly, and also *frijol*, or black beans, potatoes, a sweet pumpkin, and *chile*, or red peppers. As now, they made their picturesque clothes from the cotton of the hot lands, and the wool of the cold. But, though they lived in a Paradise, and perhaps for that fact, they do not seem to have lived in peace. The many languages surviving to this day in mere fragments of tribes, in isolated patches, and often mixed, would seem to show that many different peoples came here and took possession of the fruit of previous occupants, and were in their turn subdued or driven away from their mountain fields. Thus the cupidity and necessity of races or classes is ever making turmoil and changing the established order. These people seem fixed to their soil, like the very trees. Sometimes a village seems all that remains of a race, surrounded by other languages, unintelligible to it. The languages, traditions, and racial characters of the various tribes of Guatemala Indians are a rich field for the study of anthropologists, and is almost unknown, save what the German, Dr. Behrendt, did in his short life, and whose manuscripts fortunately fell into the hands of our own accomplished anthropologist, Dr. Brinton, of Philadelphia, who is giving the results to the world.

As we descend below 8000 feet the oak becomes an important element in the forests. There are several species of the scrub, black and willow, or chestnut kinds, and none like our white or red oaks, as far as I have seen.

As the pine characterizes the lava, ash and sandstone soils, so the oak does the limestone and schist, as well as ash soils. The oak forests are generally more sparse than others, and seem secondary; that is, have overgrown ground cleared one time by the ancient inhabitants. On lava and ash soils, especially on rocky slopes and in barrancos, the pine and oak are often mingled. Along the ancient Indian roads are rows of oaks, with curiously gnarled and curved trunks, looking very ancient. This oak often divides near the ground into two horizontal arms, and from these several vertical trunks rise up into low trees. There are also other common trees along the ancient paths, an elderberry of tree-like size and form, and a euphorbia, low and gnarled, but with trunks several inches diameter; also cactus trees, wild cherries and box elder. At this altitude, also at 8000 feet in the upper temperate belt, occurs our own well-known sweet gum, the *Liquidambar styraciflua* L. I have met it only on the Pacific side, and on one mountain of the interior, forming green groves about springs and brooks on the mountain side, while all the other trees were brown or dull in the dry season and in the dry belt.

From 7000 to 3000 feet elevation the country is so thickly inhabited, cleared and cultivated that the forests are small and unimportant, except on the Gulf slope of the mountains, where the forests are very dense and little known. I have penetrated through them for three years, yet can hardly say I have seen them. One must hew a path through them with axe and cutlass, and can see only the numberless and thickly matted and intertwined vines, lianes and briars, ferns, bamboo-grass and knife-grass, will brush and bother unending, and the close-standing trunks of the unknown trees; but their flowers or foliage never. After three years I have not yet seen the leaves of the cedar, mahogany, silk-cotton and others whose identity I have otherwise learned.

But the reason partly is that I had duties that prevented my making a special study of such matters. I have gone up mountains where the underbrush was so densely matted that my cutter ahead would open only a tunnel next the ground high enough for us to crawl on hands and knees for distances of several hundred feet at a time. Such circumstances are not favorable for observations of Nature.

At these middle altitudes fruit trees come forward ; but there are very few wild fruits—a wild plum, a wild cherry like ours, the large zapate and the manzanilla, are all that occur to me. The plum is yellow, and rather sour and astringent. The wild pigs, or peccaries, of which there are three species, are very fond of them. The monkeys, of which there are two species (the Spider and the Howling), live to a great extent on the zapate, whose tree is large and lofty. The Indians are also very fond of it, and make distant excursions into the woods to hunt for it and for wild honey. Sometimes in the depth of the woods one comes to a large zapate tree, with a rude ladder of poles fastened to the trunk extending up to the top, for gathering its fruit. Some families keep secret certain zapate and bee trees, and visit them each year. Of cultivated fruits at these altitudes there is the Agnacate (called Palta in Peru and Alligator Pear in the West Indies), the apple and the peach. There are few Indian villages and hamlets that are not rosy with peach blossoms in the season. Rose bushes, too, and geraniums in profusion are about their huts and fences. Apples are not so common, and appear to be of late introduction. Coffee comes into cultivation at 6000 feet, but thrives best at 3000 to 4000 feet.

And now comes to our notice the silk-cotton tree, or Ceibo, with its great buttressed trunk and its wide-spreading branches. This tree is very common in all the lower forests down to sea-level. The wood is light, and often used for dug-out canoes, but they last only two years without decaying. There is another tree, with a beautiful straight cylindrical trunk, whose wood is so soft and elastic that an axe almost sinks into it at one blow, and can hardly be pulled out again. There is still another peculiar tree whose wood is so hard that, in spite of efforts, I have never known one to be cut down, the cutters always giving up in despair, and when it has to be removed the Indians build a fire around it, and keep it up until the monarch falls.

Already before we pass below 3000 feet the sugar cane and cotton are planted, but coffee at 6000 and cane at 4000 are on rare occasions killed by frosts, as happened winter before last, produced by the same cold waves that carried destructive frosts to lower Florida and Cuba. Also now occur all the well-known tropical fruits, — mango, orange, lime, pineapple, plantain, custard apple and banana, and they improve downwards to sea-level.

Below 3000 feet, in the *tierra caliente*, we are in a torrid climate. Everywhere, except in the dry belt, vegetation is exuberant, overpowering. It is a hard and expensive struggle to keep ground open enough for cultivation, and neglected ground soon reverts to forest. Even in inhabited parts all the unused spots of ground are so covered that houses and fields are hidden in a general view, and it seems a marvel where all the people live who are known to inhabit the place. But the greater part of Guatemala below 3000 feet is now uninhabited, and covered with rampart forest, primitive or secondary. Two ancient cities are found in this forest, and at many other places are remains, showing that in ancient times a dense population existed where now is forest.

These forests at sea-level have been described by others in terms of admiration and rhapsody, as by Charles Kingsley, and I need not undertake it. I have travelled by canoe up and down various rivers for some 800 miles, on broad expanses with views over desolate marshes, and in profound narrow channels hemmed in by lofty precipices, and under a leafy archway, the branches of trees on the two banks meeting overhead. Sometimes two opposite fallen trees will bar the way, and an opening has to be cut. A peculiarity is that one cannot boat along the shores, for trees overhang and shoot out at all angles over the water to reach the sun with their tops. There is a palm-tree that has the peculiarity of sending its trunk out horizontally from the bank, only a few feet from the water, for some forty feet, and then turning up vertically and spreading its crown of leaves to the sun.

There are very many species of palm. Most of them are in the hot country, and in rich, moist hollows, or on river bottoms. Many send up their leaves in graceful sweeps from a subterranean stock, others rear their crowns on lofty shafts. The cocoanut palm likes the immediate sea-shore best, the manuca, flourishes along the great rivers. There is a peculiar palm that prefers the dry belt, abounds on rocky hills, and extends up to 5000 feet above sea, or over. This is highly valued, its leaves being used for weaving hats and *petates*, the mats or palm cloth universally used for sleeping rugs and for wrapping baggage and goods for transportation by mules or on the backs of Indians. Palm-leaves are very extensively used in hut-building, especially roofing; also by travelling parties, to make temporary shelters, called *Chiampas*, to pass rainy nights in the woods. But it requires the skill of the Indians to make them waterproof. In a few minutes fifty men can erect these chiampas, and sleep dry all night in a pouring rain.[1]

The mahogany, of which there are two or more species, never forms a forest, but occurs in clumps or singly among other trees, and the same is the case with the rubber tree, of which also there are several species. These trees occur scatteringly through all the forests, aggregating a great total. During a freshet I have seen hundreds of mahogany logs dashing down the rapids of the Mumacinta River, to be caught up and loaded on ships at its mouth on the Gulf. Also many cedar logs came down from the upper affluent, the Ococingo River. The rubber trees are not cut down, but only bled at intervals, until they succumb. The white sap, or rubber milk, hardens in the air to brown-black, quivering cakes, which are carried by men, mules and canoes to the sea-coast for shipment. The rubber-hunters penetrate the woods everywhere, and endure great privations; they have no fixed abiding-place, but move from tree to tree, gathering their crop pound by pound. On the contrary, the mahogany-cutters, when a place is found with enough trees for a season's cutting, build themselves a village of substantial huts and keep house, bring with them into the forest wives, children, pigs, chickens, dogs, and all their *lares* and *penates*. They may stay one year, or many. But finally, the woods being exhausted of suitable trees, they all depart, the houses decay and fall, the forest regrows and resumes its sway, and all that remains years afterwards are a few stunted banana, orange and mango trees, smothered and hidden by the lusty native forest. There is a large tree very frequent in the dry plains and low hills of the hot lands called the *ramon* tree. Its leaves are glossy green and leathery, of small size, and afford, with the twigs, a most nutritious fodder for cattle and mules. When they have it they will not touch grass. It is sweet and mucilaginous. For months my mules have depended on it. I had nothing else to give them.

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[1] On swampy sea-shores and up the swampy rivers and on coral key the impenetrable mangrove holds sway.

Last of all we come to the logwood, which grows only along the margins of sluggish rivers, lagoons and marshes and in swamps at or near sea-level. I know of two species, brazil-wood and campeachy-wood. The latter is the most valuable, I suppose, because the color of its decoction more closely imitates the color of the red wines, in whose manufacture it is so extensively used. As our imported wines bring high prices, logwood has a corresponding value. It sells by the pound. It is a heavy wood; a stick four feet long needs to be only a few inches in diameter to weigh 100 pounds. On account of its peculiar habitat it is hunted by canoe, and when cut has to be carried by canoe to some shipping-point. It cannot float. It sinks to the bottom like a stone. During the last 300 years thousands of tons of it have been shipped from Belize, and by accident so many logs have sunk to the bottom of the harbor and been lost, that now, when it is proposed to dredge the harbor to improve it and fill up certain shallows in the manner of the Potomac Flats, it is believed that the recovery of this logwood will go far towards paying for the work.

The second cause for the diversity of plant life I gave as the meteorological influence of topographical features on climate. As the moisture-laden trade winds from the Caribbean Sea reach the land, and they are deflected upwards more and more as they blow inland, and as the mountains rise higher and higher. This ascension rarifies the air, cools it and reduces its capacity for holding aqueous vapor, and results in condensation and copious rainfall. It is like squeezing a saturated sponge. When the culminating summits of the Cuilco Mountains, the Sierra Madre, Sierra de Chania and Sierra de las Minas are reached, the last squeeze is given to the sponge and the winds cross over to the interior table lands, dry. This causes a dry belt along the leeside of these mountains extending from Facaná and Cuilco in the northwest by way of Huchuetenango, Chiantla, Rabinal and Salamá to Zacapa and Chiquimula in the southeast. As the air descends from summits of 12,000 to 8000 feet high to the interior plains of only 7000 to 1000 feet elevation, it expands again and takes up moisture from the soil, dessicating the climate further and making the dry belt a very marked feature of the country. One writer even calls the low hot plains of Zacapa a "desert." The pine is very common in this belt at all elevations in favorable situations, and also the oak above 3000 feet. In the driest parts and in rocky places the character of the vegetation is special and peculiar. Cacti, thorny mimosæ, and many kinds of thorny and prickly shrubs abound. As the air rises again, or the higher currents reach the summits of the mountains facing the Pacific, the sponge, replenished from evaporation over the dry belt, is squeezed again, causing mists and copious rain, and limiting the dry belt to the south and southwest.

The Pacific slope has a moist, tropical climate of its own from the influence of the ocean winds, and is independent of moisture brought from the east.

Finally, I have to mention a third great cause affecting the forests of Guatemala; the influence of the ancient people who cleared nearly or quite all the ground that is cultivated or pastured to this day, and much more besides that has become overgrown again with forests. The general proposition will hold that all the clearings of the ancient people in the dry belt, and most of them in its semi-dry borders, have remained cleared, whether cultivated and pastured or not, excepting grass, weeds and shrubbery scattered and in clumps. But to this general rule there is a remarkable exception. In favorable situations, as to moisture and depth of soil, pine forests, with some oak, cover the ancient fields and village sites. In such clean open pine forests, terrace walls, ruined structures, and whole villages are found, but all very ruined and ancient-looking.

A great pine tree may blow over and expose under its roots a stratum full of potsherds and other remains. Not far off open pine woods may border on a dense primitive forest hardly penetrable, the line between the two sharp and distinct, showing where the ancient axeman stayed his hewing. Pine forests also cover the country about the ancient city of Quirigua, on the Caribbean Coast, and I believe cover the fields of the dense population that must have supported a city so great as shown by its numerous and artistic sculptured remains. The city of Zikál is also hidden and covered up in the deep woods, with some of its walled towers yet reaching above the great forest trees, but I do not know whether these are pines. It appears then that many primitive angiospermous forests have been replaced by pine forests through the intervention of the ancients, but in the moist hot regions other angiospermous forests have followed the primitive ones destroyed by man.

In the valleys of the Salegná and Lagartero the heavy rains have denuded the ancient fields of their soil, leaving a stony desert over many square miles, and where forests can never again find a footing. And these curious stony regions now deserted and desolate are strewn everywhere with remains of former populations.

In the Petten, in the northern part of the Republic, are great areas, bare of woods, and grass-covered, called *Sabanas*. These are also ancient fields, now unused and unoccupied except at a few small villages for raising cattle. The limestone hills and ridges remain covered with the primeval forest, and at their bases and also at the borders of the inhabited regions the line of division between *Sabana* and forest is as sharp as when the ancient man made his clearings.

I recognize two causes that in their combined action have prevented the renewal of the forest. These *Sabanas* are in the middle of the lowlands between the Caribbean Coast and the mountains. As the saturated winds reach the forests on the Coast, their cooling influence causes heavy precipitation, the same as a mountain. The coast rains are well-known. But as the winds go over the interior plains without ascending, no further precipitation takes place till they reach mountains; hence the middle plain acquires the character of a partially dry belt, so that for several months in the dry season no rains occur, and the ground is parched and the vegetation partially dries up.

Now it happens that the region cleared by the ancient inhabitants has a tough clayey soil of such a nature that it bakes dry and hard in the dry season; grass and weeds dry up, and young trees that would germinate in the wet season are as regularly killed in the dry. These Sabanas show numerous ancient remains; and these and also the pine forests deserve to be thoroughly examined by archæologists. Much might be learned to shed light on the studies already made on the more modern ruined cities and sculptured temples of Central America.

MOUNTAIN-UPTHRUSTS.

BY CHARLES A. WHITE.[1]

CERTAIN of the mountain ranges of the western portion of our national domain exhibit in a clear and striking manner the evidence that they have originated in uplifted folds of the earth's crust. One of the simplest and most characteristic of these orogenic folds is the one in which the Uinta Range of mountains originated.

Other uplifts of a similar character have occurred, but which, having been of limited longitudinal as well as lateral extent, have resulted in comparatively small clusters of mountains, and not in mountain ranges proper. The Black Hills of Dakota have originated in one of these circumscribed uplifts.

In Northwestern Colorado two uplifts occur which, so far as the character of the displacement and of the formations involved are concerned, are similar to those which have just been referred to; but they have occurred within such narrow limits, respectively, that they have each resulted in only a single mountain. The limits of each of these uplifts are so sharply defined, and the amount of vertical displacement of the strata involved is so great, that I have designated them as upthrusts.

A description of these upthrusts is the special object of this article. But as they are structurally connected with the great Uinta fold and with other neighboring displacements, it will be necessary to devote a considerable part of it to their description also.

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